Adapting the Type of Indoor Route Instruction to the Decision Point

Laure De Cock, Kristien Ooms, Nico Van de Weghe, Philippe De Maeyer

Ghent University, laudcock.decock@ugent.be, Kristien.ooms@ugent.be, nico.vandeweghe@ugent.be, Philippe.demaeyer@ugent.be

Abstract. In this study, an online survey was executed in which participants had to indicate how good they found the type of route instruction that was shown on an indoor decision point. results show that the preference for route instruction types differs per decision point category. These preliminary results will be validated in a real life experiment with an adapted mobile wayfinding aid.

Keywords. Indoor wayfinding, route instruction type, Location based system

1. Introduction

When you have to go to a meeting, you can easily find your way to the office building, but as soon as you enter, it is up to you to find the meeting room. This is because outdoors, mobile navigation aids (e.g. Google maps) are widely used, but indoors this is not yet common practice. One of the reasons for this is that most indoor environments are more complex than outdoors, for example because of the third dimension (i.e. staircases, elevators) (Giudice, Walton, & Worboys, 2010). Because of this complexity, indoor environments could benefit from more intuitive wayfinding systems, which impose a low cognitive load on the user. A more intuitive route guidance could be facilitated by providing the right amount of information at a specific place and time. To this end, adapted mobile wayfinding aids are being developed which adapt their characteristics to the context (Reichenbacher, 2003).

One possible adaptive aspect of wayfinding aids is the type of route instruction (e.g. map, photo, text,...). Every type of route instruction has specific characteristics which have a different effect on the induced cognitive load.

LBS 2019
15th Conference on Location Based Services
Vienna, 11–13 November 2019

Published in "Adjunct Proceedings of the 15th International Conference on Location Based Services (LBS 2019)", edited by Georg Gartner and Haosheng Huang, LBS 2019, 11–13 November 2019, Vienna, Austria.

This contribution underwent double-blind peer review based on the paper. https://doi.org/10.34726/lbs2019.24 | © Authors 2019. CC BY 4.0 License.

Text instructions have the advantage of imposing low cognitive load on the users, but the disadvantage is that they can only give a limited amount of information. Photos show a lot of landmark information, which can improve orientation, but the large amount of information to be interpreted can cause a rise in cognitive load. Maps can also induce a high cognitive load, because the perspective of the user has to be translated to the map (Chittaro & Burigat, 2005). Similar to photos, 3D-visualizations also show a lot of information and this type tends to be favored by participants (Kray, Elting, Laakso, & Coors, 2003). Additionally, every instruction type has a certain generation cost. Text and symbols are easily generated, but photos require more resources. Map instructions can be deduced from the floorplan and 3D simulations from the building information model (BIM), but both should be extended with realistic colors and materials (Lertlakkhanakul, Li, Choi, & Bu, 2009; Puikkonen, Sarjanoja, Haveri, Huhtala, & Häkkilä, 2009). In this research is determined which type of route instruction is preferred at which decision point in order to implement these findings in an adaptive mobile wayfinding aid.

2. Methods

2.1. Types of Route Instruction and Online Survey

The case study building of the online survey is the iGent tower in Ghent (Belgium), a modern office building that facilitates the installation of a location based system (LBS) as several location sensors can be mounted to the ceiling. In this building, ten routes were recorded on video. First of all, the route instructions for these ten routes were designed in several types. *Figure 1* shows six of these types, the remaining four are obtained by placing the text instruction below the images or videos.

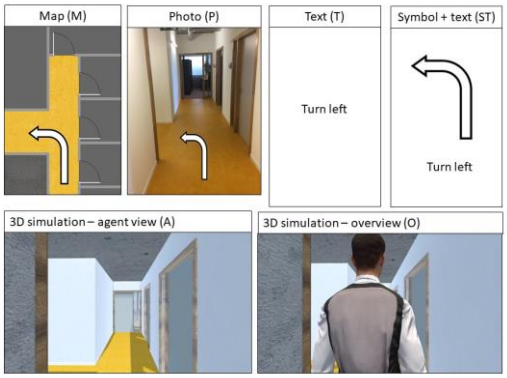


Figure 1. Instruction types.

During the online survey, participants watched the ten route videos and with every new route, a different instruction type was used. The order of the routes and instruction types were randomized. At every decision point along the routes, the route video paused and participants had to rate on a seven-grade likert scale how good they found the type of route instruction that was shown on that decision point.

2.2. Statistical Analysis

In the statistical analysis, the decision points are first categorized according to the action of the route instruction. Next, one-tailed pairwise mann-whitney U tests with Bonferroni correction are used to analyze which types of route instructions received higher ratings for each of these categories. This way, the best type of route instruction is determined for every group of decision points.

3. Results

The preliminary results are summarized in *Table 1*. For every category of decision points, an example of the recommended route instruction type is visualized: Photo + text instructions were preferred at decision points to change levels and take turns, 3D-simulations + text received higher ratings at the central decision point and symbols + text at starts end endings of a route.

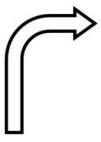
Changing levels	Taking turns
 Take the stairs to the 10th floor	 Turn left
Starting and ending a route	**Central decision point**
 The office is the first one on the right	 Go straightforward

Table 1. Overview of best route instruction types per decision point category

4. Discussion and Future Research

Generally, the photo instructions with text got the highest ratings, but when symbols with textual instructions are considered (e.g. because of their low generation cost), they are best used to start or end a route. This might be explained by a lack of landmarks. As mentioned in the introduction, photos have the advantage to enable a fast recognition of landmarks. However, in this case study building, not many landmarks are present in the hallways, as is often the case in indoor environments (Mast, Jian, & Zhekova, 2012). When no landmarks have to be recognized, a textual instruction can convey the wayfinding information with a lower cognitive load than a photo instruction. For example, it is easier to interpret the text instruction 'the office is the second door on the right' than a photo with the same message. At the other groups of decision points, more landmarks are present: the pictogram of the staircases can be recognized on a photo and at the crossings a photo gives more support than text to take turns. Most landmarks are present at the central decision point where several hallways cross. The type that gives the most complete information, 3D simulations, received higher ratings at this decision point.

The results of the online survey will be validated with a real life experiment. This validation is important in cartographic usability research, as both methods have limitations. By triangulating the results, findings can be confirmed and new issues can be detected (Roth et al., 2017). To this end, a mobile wayfinding aid has been developed, which implements the findings of the online survey by adapting the type of route instruction to the decision point. The turn-by-turn instructions of the wayfinding aid will be automatically shown at the right location. To enable this location awareness, the system uses the ultra-wideband sensors, implemented in the ceiling of the case study building. This way, it will be easier for participants to know they are still on the right track, compared to a system where they need to swipe to the next instruction. During the experiment, participants will wear a mobile eye tracker in order to measure their eye movements. This gaze data will give an indication of the cognitive load, induced by the mobile route instructions. Consequently, it will be analyzed if the adapted route instructions induce lower cognitive load than non-adapted route instructions.

5. Conclusion

To guide people indoors, adaptive mobile wayfinding aids are being developed, which adapt the given route information to the user and the environment. In this study an online survey was conducted to investigate how the type of route instruction can be adapted to the decision point. this research

showed that different types of route instructions are preferred at different categories of decision points: text to start or end a route, 3D simulations for central crossings and photos for other decision points. These preliminary results will be validated in a real life experiment, to test if adapted route instructions ease wayfinding.

References

Chittaro, L., & Burigat, S. (2005). Augmenting audio messages with visual directions in mobile guides. In *Proceedings of the 7th international conference on Human computer interaction with mobile devices & services* (pp. 107–114). Salzburg. https://doi.org/10.1145/1085777.1085795

Giudice, N. A., Walton, L. A., & Worboys, M. (2010). The informatics of indoor and outdoor space: a research agenda. In *Proceedings of the 2nd ACM SIGSPATIAL International Workshop on Indoor Spatial Awareness* (pp. 47–53). New York: ACM. https://doi.org/10.1145/1865885.1865897

Kray, C., Elting, C., Laakso, K., & Coors, V. (2003). Presenting Route Instructions on Mobile Devices. In *Proceedings of the 8th international conference on Intelligent user interfaces* (pp. 117–124). New York. https://doi.org/10.1016/b978-008044531-1/50445-0

Lertlakkhanakul, J., Li, Y., Choi, J., & Bu, S. (2009). GongPath: Development of BIM based indoor pedestrian navigation system. In *5th International Joint Conference on INC, IMS, and IDC* (pp. 382–388). https://doi.org/10.1109/NCM.2009.179

Mast, V., Jian, C., & Zhekova, D. (2012). Elaborate Descriptive Information in Indoor Route Instructions. In *Proceedings of the 34th Annual Meeting of the Cognitive Science Society* (pp. 1972–1977). Sapporo, Japan: Austin, TX: Cognitive Science Society.

Puikkonen, A., Sarjanoja, A.-H., Haveri, M., Huhtala, J., & Häkkilä, J. (2009). Towards Designing Better Maps for Indoor Navigation – Experiences from a Case Study. In *Proceedings of the 8th International Conference on Mobile and Ubiquitous Multimedia*. Cambridge. Retrieved from http://delivery.acm.org/10.1145/1660000/1658566/a16-puikkonen.pdf?ip=157.193.167.179&id=1658566&acc=ACTIVE SERVICE&key=D7FC43CABE88BEAA.F15FE2ACB4878E3D.4D4702B0C3E38B35.4D4702B0C3E38B35&CFID=827097637&CFTOKEN=89931556&__acm__=1510138566_01719b90c0d4a76a5

Reichenbacher, T. (2003). Adaptive methods for mobile cartography. In *proceedings of the 21th ICC*. Durban. https://doi.org/10.1044/1092-4388(2010/10-0131)durations

Roth, R. E., Çöltekin, A., Delazari, L., Filho, H. F., Griffin, A., Hall, A., … van Elzakker, C. P. J. M. (2017). User studies in cartography: opportunities for empirical research on interactive maps and visualizations. *International Journal of Cartography*, *3*(S1), 61–89. https://doi.org/10.1080/23729333.2017.1288534